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ABSTRACT

As one of four options under English 105 at Western Michigan University, the course "Writing and Science" is intended to help students become better communicators as they enter college. The first assignments are in technical writing--descriptions of a mechanism, a process or a mechanism in operation, and a behavior. Emphasis in these exercises is on economy of words, letting the organization of the topic organize the writing, and theory and experiment. Two important aspects of the course are the large amount of linguistics covered and the kinds of writing other than scientific writing which the students do, such as biography and speculative prose. Throughout the course, the student becomes aware of the ways in which writing can be useful for a scientist. (JM)

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WRITING & SCIENCE

A Freshman Writing Course for Science Majors

"The session ended with the question of how to approach composition in an interdisciplinary manner still unresolved to the satisfaction of some members of the audience."
--Workshop report from annual meeting, 1973.[1]

I am tempted in this forum[2] to hold a brief for interdisciplinary studies in general. Many English teachers need to be told that one can develop valuable courses in conjunction with departments outside the humanities. My own experiences have proven quite rewarding.[3] I am further prompted to hold forth because of the nonsense so often heard at conferences. Last year at the 4C's I heard someone say that "their department couldn't do anything for science majors." Or I see an article like "Interdisciplinary Studies, the Latest Experimental Rage" by Joan Baum in the February, 1975, issue of College Composition and Communication, and I get an urge to tell the carping critic a thing or two. Add to those experiences the frustrations of trying to get a professed--or professored--interdisciplinarian to come across with actual support for course development, and one has plenty of reason to rage.

Since we have not yet fallen to the depths of some organizations, however, wherein the surest way to insure publication is to carp against the carpers, and since for at least some of this audience I would be preaching to the already-converted, let me end this introductory invective by saying that I have nothing more to say about interdisciplinary studies in general. Rather, I will talk very directly about the nuts and bolts of one class which I have been developing and teaching for a year and a half now. The questions to be addressed are not of cosmic significance.

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1. "Ways to Cross Disciplines in Teaching," CCC, XXIV, 3 (October, 1973), 325.
2. Panel session on Writing As Problem-Solving in Interdisciplinary Courses at the annual Conference on College Composition and Communication, St. Louis, Missouri, March 15, 1975.
3. Arlen R. Zander, "Science and fiction: An interdisciplinary approach," American Journal of Physics, XLIII, 1 (January, 1975), 9-12.

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They consist of mundane how-to's for getting twenty science majors (with an occasional Electrical Engineering Technology student from Persia) to write well on scientific subject matter--and other things--in the English language.

Western Michigan University has no college English requirement. Writing & Science is one of four options under English 105, the department's introductory writing course. The College of Applied Sciences offers one course in Technical Communications. The College of Business offers two courses, Informational Writing and Business Communication. The English department also has an umbrella course, English 305: Practical Writing, which includes Pre-professional Writing and Research and Report Writing. This last course is the upper division course in technical writing generally recommended by the experts, it being well known in the field that the most salutary time to focus on the communication skills of science and technology majors is when they have a fund of experience and a fear of unemployment.

Writing & Science is intended to help students become better communicators as they enter college. It deals with the uses of language for general benefit and, although many of my colleagues cringe, for the immediate service of improving the student's command of written English. In order to pay some obeisance to the title of this conference session, the operation of Writing & Science in regard to problem-solving is probably best captured in a question posed by a junior pre-med student who enrolled in the first section of the course by deliberate election and who continued to blackmail all of us with the purity of his intention. He asked, "Can I learn to improve my writing by only writing scientific stuff?" That question remains the touchstone of the course.

My own quest for quality in teaching has so far led me to two hypotheses which apply to Writing & Science. The best teachers I have ever known involve their students in activity immediately, and they continue with as much activity as they can set up and stand. The best teachers in higher education frequently involve their students in solving the kinds of problems which are real problems for the teacher. A good question is worth a thousand answers. What distinguishes Writing & Science from all other courses is its central question: What is scientific writing? In order for me to be able to pose that question in a meaningful way, however, I first need to clear away the debris of several years of schooling and to have the student focus on real scientific writing.

The course begins with three handouts: a course description, a syllabus, and an assignment sheet for the first writing. (Dittoed copies attached.) On day one I

talk a lot. Students are not expected to know; they are expected to learn. They should approach the assignments as they would approach lab work--as work not immediately productive in itself, but as a means to learning skills which will eventually become productive. One gets a certain number of trial balances to come up with an accurate response. I answer a lot of questions, usually about homework and grades. In the first three sections I taught I made extensive use of sentence-combining exercises and that took some additional time to explain, but I have since abandoned the sentence-combining.

The first three assignments are in technical writing; they are descriptions of a mechanism, a process or a mechanism in operation, and a behavior. Several emphases operate in, and in response to these exercises. First, I try to get the writing cut to its barest essentials. I recommend Strunk & White's The Elements of Style. I repeat frequently the famous Strunk lecture: "Omit needless words." In every paper I bracket all the extraneous sentences, clauses, phrases, and words I can find. I rewrite for conciseness. I select examples from papers and we spend class time cutting and compressing the statements.

The second major emphasis is on letting the organization of the topic organize the writing. A burette clamp has two distinct parts, so the written description of it will have two distinct parts. If the two parts have a simple connection, then the parts of the description need only a simple connection. Most important, if a picture or a graphic presentation will help make clear the exact nature and relationship of the parts, it should be used. Rather than a kind of false invention directed at jazzy ways of saying something, the proper problem for the beginner is to find the language which best represents the topic on its terms.

Most freshman English students bring with them strange notions about form. Science majors as well as the rest have been subjected to what Janet Emig calls the "Fifty-Star Theme."[4] Introduction-body-conclusion is just the most concrete of a whole pile of stumbling blocks, such as outlining, topic sentences, transitions, and sentence variety, all of which research in the teaching of writing has shown are not used by real writers or, if they are, certainly do not appear with near the frequency of attention they are given in the schools. Contrary to what many uninformed conservative teachers believe, scientific and technical writing are not appropriate ways to reintroduce all that old garbage. Such formalism does not facilitate good

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4. Janet Emig, The Composing Processes of Twelfth Graders (Urbana, Illinois: National Council of Teachers of English, 1971), 97-100.

scientific writing. Indeed, one doubts that such unexamined servitude facilitates anything more than the rite de passage called high school and college.

My own approaches to the question derive from my continuing interest in new rhetoric and in classical rhetoric, since they amount to the same thing if we restore invention, heuristics, language, and overall harmony to the classical concerns of voice, style, and form. I employ modern notions of invention from wherever I find them. Proceeding inductively, I try to fit them to real communications. For instance, the notion of the logic of content is derived from phenomenology.[5] When I find a science writer, as in this case Francois Jacob in The Logic of Life (Pantheon, 1973), who uses such a notion to structure his writing, I try to pass the notion along to my students. We focus on how the notion works in practice, rather than on the philosophical analysis.

In addition to economy and logic of content, a third emphasis in the technical writing assignments is the interplay of expectation and phenomenon, or, if you prefer, theory and experiment. By the time the students write their description of a behavior they are usually comfortable enough with the logic of content to examine the body of common law of science which they bring to their work. What T. M. Sawyer calls the common law of science[6] is that body of precedent by which we judge the validity of a scientific endeavor and its outcomes. My own term for this is the rhetoric of science. Within the two weeks following the third technical writing I try in as many ways as possible to communicate this idea to my Writing & Science students.

None of the ways I pose this fundamental hypothesis seems sufficient in itself, since so many people learn in so many different ways, but let me enumerate a few. First, I give out two dittoed statements, "Beyond Technical Writing" and "Scientific Writing" (attached). In these I try to say what I am after. Second, we read and discuss two articles, one by Nikolaas Tinbergen and one about Tinbergen. We look at how the scientific nature of Tinbergen's work is expressed. Third, we examine the students' papers for expressions of scientific common law. Fourht, we use the process of preparing abstracts, both as a collaborative in-class activity and a written assignment, to get a handle on what is scientifically important in scientific writing.

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5. Maurice Merleau-Ponty, "Phenomenology and the Sciences of Man," in Maurice Merleau-Ponty: The Primacy of Perception, edited by James M. Edie (Evanston: Northwestern University Press, 1964), 52.
6. Thomas M. Sawyer, "The Common Law of Science and The Common Law of Literature," CCC, XXI, 5 (December, 1970), 337-41.

While the superficial justification for this enumeration of the ways is how do I love thee, the underlying motive springs from how I wonder what you are. Because those are both large and open-ended questions, the notion of a rhetoric of science is a heuristic device[7] which occupies us for the rest of the semester.

However, the way to enlightenment is not only through theorizing. Practice is equally necessary. So the first major paper of the course is an exercise in scientific writing based on their understanding of the question posed. Typical examples of these papers, taken from this semester's class, are "The Transport and Incorporation of I^{131} into the Thyroid Gland," "Plasma Cholesterol in Man," "Interpreting Reef Structures in the Rock Record," and "Evolution of the Theory of Coordination Chemistry." The students do several more papers of this kind during the semester, the culmination for most of them being a long paper toward the end of the semester. Before I get to that, though, let me take a moment to consider some questions these sorts of scientific papers pose for most teachers who have never done this sort of thing before.

How do I understand what they are writing about? Although I am very much interested in science, I cannot, of course, know nearly enough to understand all of what they write. On the other hand, I keep in mind the question that pre-med student asked, and I try to maintain a hard line. I think it is criminal for a teacher to make a student conform to the teacher's limitations. I encourage my students to write as though they were writing for a specialist in their field. Surprisingly, that usually makes their work easier to read. For instance, it is easier that way to hew to the logic of content. And I try to learn as much as I can. The paper on the incorporation of iodine represents a standard experiment, so I have seen others like it. How do I know it was not stolen or plagiarized? I know because the writer was having me go over it before he turned it in to his science teacher.

If I do need to understand something technical, I have at my beck and call one of the finest resources of modern civilization--an American multiversity. To find out about coordination chemistry, I call the chemistry department. When I explain that I am helping chem majors learn to write better, I usually find an instant ally.

The patterns I set up for the earlier papers hold in good stead for the later ones. A student may write a series

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7. See Sister Janet Lauer, "Heuristics and Composition," CCC, XXI, 5 (December, 1970), 396-404.

of papers on one subject. Frequently, but certainly not in the majority of cases, these earlier papers may become part of a big, final paper. It is interesting to note that I often have to encourage a student to write a series of papers or to submit a paper to Writing & Science before it goes to another teacher. More of those academic shibboleths stand in the way--disciplinary compartmentalization and the notion that one must do one's own work, meaning different work for different courses. When they get the message, though, the results are sometimes startling. Last year I saw one paper that was over one hundred pages long. Written both for Women's Studies and Writing & Science, it was a comprehensive research paper on cancer in women. This past fall a student "pulled together for himself" two year's work on experiments with enzymes. He had satisfied all his science requirements; the paper gave him a chance to satisfy himself. The most interesting paper I saw last year was a study of pesticides which put together their pathological effects on insects and humans with the economic aspects of production and reached some very balanced conclusions on guidelines for production, use, and protection. In each of these cases the students saw the research paper as an opportunity to do work which gave them high personal and academic satisfaction. The size and complexity of the papers was in large measure the direct result of their understanding of ways in which writing can be useful for a scientist.

Let me finish with three final items which are more closely allied with English teaching as we more commonly know it. Subtitle it, if you will, why I still have a place in the English department.

I teach more linguistics in this course than in any other writing course I have ever taught. The science major is usually surprised and pleased to find out that there is some scientific support for what we teach about language and its uses. He is much more receptive to modern grammars, modern notions of usage, and the other conventions of linguistics than are humanities students. The common law of linguistics makes sense to the scientist in ways that are harder for the humanist to grasp.

One of the most important aspects of this course is that I also try to get the students to do other kinds of writing than just scientific. One reason is that the contrast makes analysis of scientific writing easier. Another reason is based on Janet Emig's contention that writing in more than one mode strengthens both modes.[8] I also find persuasive

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8. Emig advanced this idea during her presentation, "Acting on What We Know," at the NCTE convention, November 30, 1974.

Donald Graves's idea that the less assigned writing one gives, the more likely one is to get more unassigned writing, as long as the students have a sense that writing is a valuable way to communicate.[9] I believe this attitude is largely responsible for the lengthy final papers. I try to build that notion into the course early by suggesting some non-scientific writing. One paper is on a historical figure in science. The attitude of the students toward this paper seems to be more casual and at the same time more personal. It is not a "hard science" paper and they generally choose a figure in whom they have a strong personal interest. The greatest benefit comes from the practice in citing source material. Since much of what they will write as undergraduate science majors will be derived from the writings of other people, the assignment is worth the time. I also ask them to write a speculative piece. Such an exercise allows for imagination, playfulness, and use of the reflexive or intensive mode, and it is a non-threatening assignment.

As for the general encouragement of non-scientific writing, well, sometimes that comes about in strange ways. In the first section that pesky pre-med student objected violently to anything that smacked of opinion as being unscientific. Since his opinion tended to dominate (second to mine, I suppose), I decided to go along with him. We got the entire class to agree to the total proscription of opinion in their scientific writing. With opinion proscribed in their assignments they soon began asking me to look at a lot of unassigned writing. The pre-med student, by the way, was the first to ask if he could substitute an opinion paper for a regular assignment. He was worked up over the DeFunis case and he needed to see what he had to say about it. Other papers soon followed from other students--one on genetics and intelligence, another on the pollution of a favorite upper Michigan trout stream, and one frustrated love affair. After we regained our balance, we applied our new perspective to scientific writing and saw where and how opinion had a place. What if they had not given in? Then I suppose we would have learned something else about the heuristic nature of the problem we were dealing with. The answers to the right question may be found in any number of ways.

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9. Donald H. Graves, "Children's Writing: Research Directions and Hypotheses Based Upon An Examination of the Writing Processes of Seven Year Old Children," unpublished doctoral dissertation, SUNY Buffalo, 1973. University microfilms #74-8375.